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UNITED STATES BUREAU OF MINES
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WORKING AN UNDERGROUND MINE SIX YEARS WITHOUT LOST-TIME ACCIDENTS[1]

By C. A. Herbert[2]

The mine of the Alpha Portland Cement Co., Ironton, Ohio, working in a bed of limestone 96 feet thick at a depth of approximately 510 feet below the surface, has established a wonderful safety record, having operated 6 years—from September 21, 1926, to September 21, 1932 - without a lost-time accident. This mine, with 61 to 86 employees (average 68) and daily output of 1,000 to 1,200 tons of limestone, operated 1,041 days during the 6-year period, or the equivalent of 578,894 man-hours of exposure.

Immediately above the limestone is a 20-foot bed of hard sandstone. At present about 10 feet of limestone is left up as a roof and about 42 feet is being extracted. Of the lower portion of the bed it is believed that about 25 feet immediately below the present workings is suitable for cement and will be extracted later.

The mine workings are reached by two rectangular concrete shafts, one a 2-compartment hoisting shaft and the other a 2-compartment air and escape shaft. In the latter shaft one compartment is used as an airway and the other as a cage compartment for a man and material cage.

The tipples at both the air shaft and hoisting shaft are of steel. The ground landings at both shafts are fenced in with hand-operated gates in front of the cage compartments.

The two shafts and the crushing plant, which is a part of the hoisting shaft tipple structure, are adjacent to the mill buildings.

The rock is hoisted on self-dumping cages in 4 ton capacity, end-gate, steel cars.

An electric hoist with automatic overwind device is used at both the main shaft and air shaft. The controls for the main hoist are in the tipple where the engineman is stationed and from which point he has an unobstructed view of both the ground landing and the cage coming into the dump.

PRODUCTION AND UNDERGROUND EMPLOYMENT

The mine produces 1,000 to 1,200 tons per day of 8 hours and the plant is working at full capacity. There are now 61 employees, but as said, the average employment was 68 during the 6-year period.

LIGHTING

The men use carbide lamps. The mine bottom, switches, and partings are lighted by electricity, and the electric shovels have flood lights.

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1 - The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from the U. S. Bureau of Mines Information Circular 6677."

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VENTILATION AND METHOD OF MINING

The mine is developed by the room-and-pillar method, and unlike many other limestone mines it has a well-planned ventilation system. The rooms are turned from entries in which the crosscuts have been closed with concrete brattices to create a definite circulation of air; these are also built in rooms where necessary to force the air along the faces. The mine is dry and of even temperature throughout the year, and the working conditions are excellent.

Approximately 75,000 cubic feet of air per minute is forced down the air shaft by a motor-driven centrifugal fan on the surface. A duplicate fan is installed at the bottom of the air shaft as a reserve.

As originally opened, rooms and entries were about 27 feet high and about 25 feet wide, but as the stratum being left for a roof did not stand well, the height of rooms was increased to about 41 feet to reach a strong, hard stratum of rock which gives little or no trouble from roof falls; the width of the working places has also been increased to 35 feet. The company is now starting back through the old working places and enlarging them to the dimensions given; this is accomplished by first shooting off the ribs, which fills up the place sufficiently with broken rock to enable the men to work on top of it to drill and shoot the top.

In the advance work, mining is by the heading-and-bench method, using two benches. The heading is driven 16 feet high, the top bench 16 feet high, and the lower bench 9 feet high. The heading and top bench are usually advanced two rounds or 18 feet before the bottom bench is lifted by 18-foot horizontal shots.

The rock is loaded into the cars by means of Thew electric tractor-mounted shovels operated on 250 volts d.c.

Drilling is done with tripod-mounted hammer drills operated by compressed air.

BLASTING

All blasting is done with 40 per cent ammonia dynamite, no-delay and first and second delay detonators and blasting battery, by a crew which starts charging holes at noon; no shooting is done until the day shift is out of the mine. The shot holes are stemmed with sand-filled dummies. As all shots in any one place are not fired simultaneously, it is necessary for the blasting crew to return to the face during blasting; however, the places are shot in rotation and enough time elapses between the firing of the different rounds in any one place to permit the smoke to clear up.

Only one day's supply of explosives is allowed in the mine; the explosives are taken into the mine in a wooden car hauled by mule and are kept in a locked magazine until needed by the blasting crew. Detonators are taken into the mine separately from the explosives and kept in a special magazine.

The rock is well stratified and breaks up well when shot; it is seldom necessary to do secondary blasting; but when it is, one of the crew that scales off the loose rock from roof and ribs is assigned to this work. Secondary shooting is done during the shift by drilling holes in the rock and using light charges of dynamite and fuse.

Misfires are infrequent; when one does occur, the stemming is withdrawn with a copper needle, a new primer is placed, and the hole is again shot. In loading the holes originally, the primer is put at the bottom of the hole so that there is essentially no danger of striking the detonator when withdrawing the stemming. There has never been an explosives accident at this mine.

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HAULAGE

Mules and one storage-battery locomotive are used in gathering at the face; haulage is done by storage-battery locomotives. The track is exceptionally well laid, with 35-pound steel on heavy wood ties to a 38-inch gage. All motor trips are handled at low speed, and as no tripriders are worked it is necessary for the motorman to stop the trips to throw switches. At the junction point of the main and side entries a trapper is employed to control the ventilation doors and to act as a trip despatcher.

The absence of loose rock along the floor of the rooms and haulageways was particularly noticeable, and except at the face where the rock was being loaded, the mine workings were generally clean from wall to wall.

CONTROL OF HAZARDS FROM FALLS OF ROCK

Because of the height of the workings, probably the greatest hazard is from falls of rock from roof or ribs. The roof is extremely good after the loose rock caused by blasting has been scaled off; with the roof about 41 feet above the floor, this matter of removing loose roof material naturally offers a considerable problem.

Eight men are employed to keep the roof and ribs safe from loose rock. Iron ladders are used for inspection and scaling of the ribs up to about 29 feet; to inspect and scale the roof and the ribs above 29 feet, two electrically operated derricks or cranes mounted on tractors are used, the power being supplied through trailing cables.

The boom of the crane is built like an extension ladder and can be lengthened or shortened as desired. It can also be swung from side to side or raised or lowered by power controls. On the outer end of the boom there is a platform about 4 feet square with an iron pipe railing extending around it on which the men work while trimming off the loose rock.

The use of these long ladders for trimming the ribs or walls appears to be extremely hazardous; it is remarkable that men can swing a sledge hammer or handle a bar while perched on top of one of these ladders, without sooner or later meeting with disaster, but apparently they become expert and are able to protect themselves from accident. The blasters must also use ladders in getting up on the benches, which adds to the hazards of the mine; but here again the practice appears to be well safeguarded as to actual occurrence of accidents.

After the face has been blasted, a careful inspection of the roof and ribs is made and any loose rock is pulled down before anyone is allowed in the place.

Five or six feet down from the roof a stratum of dark limestone, known as "black stone," occurs interspersed with vertical joints that not only cause it to be affected by blasting but also to weather badly along the haulage and traveling roads where it is exposed to the air. As a result, this stratum of rock was continually spalling and created a severe hazard due to its height above the floor. To overcome this danger, the company decided to gunite this band of rock along the ribs or walls in both rooms and entries. The guniting proved so effective that it is now applied to the freshly exposed band of rock as the faces of rooms and entries advance, and has apparently removed the hazard completely.

Twice each year the ribs and roof of all the working sections of the mine are given a careful inspection.

ELECTRICITY

The underground electrical equipment is operated on 250 volts d.c. taken into the mine in armored cables at the air shaft. All power lines underground are carried along the roof with drops at convenient points for attachment of trailing cables. Heavy rubber-covered

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trailing cables are used and are maintained in excellent condition.

SAFETY ORGANIZATION

The safety program of the mine is a part of the general plant program and is comparatively simple.

Each month a safety meeting of all supervisory officials is held under the leadership of a permanent chairman—the mine superintendent. At these meetings a temporary chairman is chosen to preside at the following meeting, and he, with another official who is chosen at the same time, makes a thorough inspection of the entire plant in the intervening period and reports any dangerous conditions or practices that may have been observed; at the next meeting this report is discussed, as well as information on accidents that may have come in from the Portland Cement Association, the National Safety Council, or other sources.

No special safety engineer is employed at the mine, neither are any general safety meetings held, nor is there an employee safety organization. The backbone of safety work is supervision, and the development of employees into specialists who become familiar with the hazards of their occupation and what may be done to overcome them.

Good housekeeping has doubtless played a part in making this record possible, as the mine both on the surface and underground is kept scrupulously clean and orderly. Many of the men in the mine and about the plant have received first-aid training from the United States Bureau of Mines, and they have been kept familiar with first-aid work by company instructors. A well-equipped first-aid station is maintained underground; on the outer wall of this room and along the main entry is a lighted bulletin board on which are displayed posters of the National Safety Council and general plant notices or rules. The plant doctor visits the property daily and inspects all first-aid cases in the plant and in the mine.

No printed safety rules have been issued, but the foremen instruct employees in such rules as are formulated at the regular monthly foremen's safety meetings. A foremen's safety code which covers the responsibility of such men has been prepared by the company for the guidance of its foremen. The general safety committee is divided into five subcommittees—the inspection, fire, first aid and sanitary, publicity, and educational committees; and, if necessary, an investigating committee is appointed.

According to a paper written by the superintendent, F. C. Brownstead, the success of accident prevention at the entire Ironton plant is attributable to education and cooperation. It has been found by this organization that the foremen are the logical persons to have on a safety committee; in fact, little progress was made until the responsibility for accidents was placed on the foremen. After a shutdown and before resumption of work all the men are called together and urged to be careful. Eye protection is aided by the compulsory wearing of goggles when the nature of the work requires them, because prior to 1925 many accidents were caused by flying chips of stone and steel; each man is charged $1.10 a pair, but the company keeps the goggles in repair free and refunds the money when the employee leaves. The rule requiring men to have goggles with them at all times eliminates any excuse for an eye injury. Apparently it has also eliminated eye injuries.

Every new man is given a thorough physical examination. If a man receives a slight injury which may handicap him on his regular job he is transferred to some other job temporarily, but no job is created for him. The cooperation of the company in accident prevention favorably impresses the men. Employees of the Alpha Portland Cement Co. receive a cash bonus of 1 per cent of their earnings for each month their plant operates without a lost-time accident. Because of its outstanding record the cash bonus of the Ironton plant was increased to 2 per cent in 1930 and is still being paid. The average monthly bonus for 31 consecutive months was $1.25 and is a form of recognition which is appreciated.

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This company has had an outstanding accident experience—not a lost-time accident in the entire plant since December 8, 1926. On January 1, 1932, the entire plant had operated 1,849 days without a lost-time accident; the no-lost-time accident record at that time was exceeded by only one other plant—namely, the Lehigh Portland Cement Co.'s plant at Iola, Kans., which on January 1, 1932, had operated 1,939 days without a lost-time accident. Since January 1, 1931, to date (September 26, 1932) the Ironton plant has operated 289 additional days, or a total of 2,138 days, without accident.

In 1928, the mine at Ironton won the "Sentinels of Safety" trophy for nonmetallic mineral mines in the National Safety Competition of that year, and on January 1, 1931, the Alpha Company was awarded a Joseph A. Holmes Safety Association certificate, at that time having worked its entire plant 1,484 days without a lost-time accident. In addition, the Ironton plant has won the Portland Cement Association trophy five consecutive times for having operated an entire calendar year without a lost-time accident.

Unquestionably, the very fine safety performance of both the underground mine and the entire plant is due in large part to the excellence of the supervision; the fact that the underground mining work has been conducted for six years without a lost-time accident, even though such work is normally held to be extra hazardous and to be inherently subject to accidents of both minor and major character, indicates that when efficient industrial plant safety methods are applied intelligently to underground mining work, essentially the same excellent safety results can be achieved as are now being obtained rather generally in well-operated industrial plants.

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